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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/810,309

03/26/2004

Isamu Akasaki

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26021 7590 03/16/2007

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EXAMINER

LE, THAO X

ART UNIT

PAPER NUMBER

2814

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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3 MONTHS

03/16/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/810,309	AKASAKI ET AL.	
	Examiner	Art Unit	
	Thao X. Le	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 December 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2,4,6,8,10-13,19 and 33-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2,4,6,8,10-13,19 and 33-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 19 Dec. 2006 has been entered.
2. The indicated allowability of claims 2, 4, 6, 8, 10-13, and 19 is withdrawn in view of the newly discovered reference(s) to Taki (US 7041519).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.
4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

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not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 2, 4, 8, 10-12 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over 7041519 to Taki in view of US 6586819 to Matsuoka.

Regarding claims 2, 10-12, Taki discloses a semiconductor apparatus in fig. 2 comprising: a substrate 61 made of a diboride single crystal expressed by a chemical formula XB_2 , in which X includes at least one of Ti, Zr, Nb and Hf, column 8 line 65; a semiconductor buffer layer 62 formed on a principal surface of the substrate 61 and made of $(AlN)_x(GaN)_{1-x}$ ($0 < x \leq 1$) or AlN when $x=1$, column 7 line 64, a nitride semiconductor layer 64 or 63, col. 8 line 8, formed on the semiconductor buffer layer 62, including at least one kind or plural kinds selected from among 13 group elements and As, column 8 line 10, wherein the thickness of the semiconductor buffer layer 62 made of $(AlN)_x(GaN)_{1-x}$ is about 30 nm, col. 7 line 64.

But Taki does not disclose a semiconductor apparatus wherein an angle θ_1 , formed by a normal line of a principal surface of the substrate and a normal line of a (0001) plan of the substrate is $0^\circ < \theta_1 \leq 0.55^\circ$

However, Matsuoka discloses a semiconductor apparatus wherein an angle θ_1 (tilt angle), fig. 3C-D, formed by a normal line of a principal surface of the substrate and a normal line of a (0001) plan of the substrate is $0^\circ < \theta_1 \leq 2^\circ$, col. 8 line 38. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the substrate tilt angle teaching of Matsuoka with

Taki's device, because it would have formed a flat surface and good crystallinity as taught by Matsuoka, col. 4 line 9.

Note: 'the 13 group element' is being defined as Group III B comprises Ga, Al, In, H, and Ti.

Regarding claim 4, Taki discloses the semiconductor apparatus of claim 1, wherein the substrate 61 is of ZrB_2 or TiB_2 , column 8 line 65.

Regarding claim 8, Taki discloses the semiconductor apparatus of claim 2, wherein the semiconductor buffer layer 2 is AlN, column 7 line 64.

Regarding claim 13, Taki does not disclose the semiconductor apparatus of claim 2, wherein x of the semiconductor buffer layer made of $(AlN)_x(GaN)_{1-x}$ is $0.4 \leq x \leq 0.6$.

However, Taki discloses the buffer layer 62 is made of AlN or $(AlN)_x(GaN)_{1-x}$ ($0 < x \leq 1$) when $x=1$. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the buffer layer teaching of Taki in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

The formula $(AlN)_x(GaN)_{1-x}$ is $0.1 \leq x \leq 0.1$ or $0.4 \leq x \leq 0.6$ is being interpreted as for example when $x=0.4$, then it would be $Al_{0.4}N_{0.4}Ga_{0.6}N_{0.6}$. Thus, this formula would be chemically equivalent to $Al_{0.4}Ga_{0.6}N$.

Regarding claim 19, Taki discloses the semiconductor apparatus of claim 2, wherein the substrate is eroded and removed by etching.

The process "eroded" or "etching" in claim 19 do not carry weight in a claim drawn to structure. In re Thorpe, 277 USPQ 964 (Fed. Cir. 1985). In addition, the recitation of 'eroded' or 'etching' of the claimed invention does not result in a structural difference between the claimed invention and the prior art, thus claimed invention is only an art recognized suitability for an intended purpose, MPEP 2144.07.

6. Claims 6, 33-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over 7041519 to Taki and US 6586819 to Matsuoka as applied to claim 2 above and further in view of US 6566218 to Otani et al.

Regarding claims 6, 34, Taki discloses the semiconductor apparatus wherein the substrate 61 comprises ZrB_2

But, Taki does not discloses the substrate is a solid solution containing one or a plurality of impurity elements of 5 atom % or less (zero impurity is less than 5), the one or a plurality of impurity elements being selected from a group consisting of Ti, Cr, Hf, V, Ta and Nb when the substrate is of ZrB_2 .

However, Otani discloses a semiconductor device wherein the substrate comprises a solid solution containing one or a plurality of impurity elements of 5 atom % or less (zero impurity is less than 5), the one or a plurality of impurity elements being selected from a group consisting of Ti, Cr, Hf, V, Ta and Nb when the substrate is of ZrB_2 , see abstract. At the time the invention was made; it

would have been obvious to one of ordinary skill in the art to use the impurity teaching of Otani with Taki's substrate, because it would have improved the coherence of the substrate to the lattices of the nitride semiconductor layer as taught by Otani, see abstract.

Regarding claims 33, 36-38, the combination of Taki and Matsuoka disclose the limitation of claim 33 as discussed in the above claim 2, except the substrate made of TiB_2 .

However, Otani discloses a semiconductor apparatus wherein a substrate can be XB_2 wherein X contain Ti or Br, see abstract. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to replace the ZrB_2 substrate of Taki with TiB_2 substrate teaching of Otani, because such substrate substitution or replacement would have been considered a mere substitution of art-recognized equivalent values, MPEP 2144.06

Regarding claims 39-40, see rejection of claims 19 and 13 above.

Response to Arguments

7. Applicant's arguments with respect to claims 2,4,6,8,10-13, and19 have been considered but are moot in view of the new ground(s) of rejection.

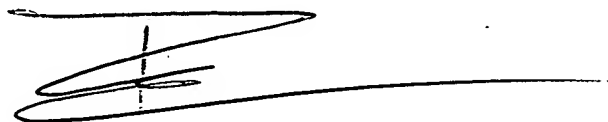
Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

14 Mar. 2007

A handwritten signature in dark ink, consisting of a stylized 'T' and 'L' with a horizontal line extending to the right.

THAO X. LE
PRIMARY PATENT EXAMINER